

REMARKS

This Preliminary Amendment accompanies a Request for Continued Examination. No new matter is believed to be added in the application by this Amendment.

Status of the Claims

Claims 2 and 13-24 are pending in the application. Claims 13, 16, 19 and 22 have been allowed by the Examiner. Claims 2, 14, 15, 17, 18, 20, 21 and 23 stand rejected. Support for the amendments to claim 2 can be found in Figure 2 and at page 13 of the specification. Support for newly added claim 24 can be found in Figure 7 at page 14 of the specification.

Interview with the Examiner

Applicants thank the Examiners for graciously conducting an Interview with Applicants' representative on July 18, 2002. The Interview Summary has been reviewed and it appears to accurately reflect the content of the Interview.

Rejections Based Upon Mitani and Wristers (Paragraphs 2-8 of the Office Action)

Claims 2, 14, 15, 17, 21 and 23 are rejected under 35 U.S.C. 103(a) as being obvious over Mitani (U.S. Patent No. 6,191,463 B1)

in view of Wristers (U.S. Patent No. 5,674,788). Claims 18 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mitani in view of Wristers and further in view of Gardner (U.S. Patent No. 5,851,888). Applicants traverse these rejections and respectfully request reconsideration and withdrawal thereof.

The Present Invention and Its Advantages

The present invention pertains to an insulated gate transistor having a substrate over which a gate insulator and a gate electrode is formed. The gate insulator includes silicon and oxygen and additionally contains both nitrogen atoms and fluorine atoms. The nitrogen atom concentration of the gate insulator is more than $1 \times 10^{20} \text{ cm}^{-3}$. As set forth in instantly amended claim 2, the "flat band voltage is stable even if fluorine injection occurs." See Figure 2 and page 13 of the specification. As set forth in new claim 24, the interaction of nitrogen and fluorine reduces the deterioration of transconductance. See Figure 7 and page 14 of the specification.

Distinctions of the Invention Over Mitani, Wristers and Gardner

Mitani pertains to an apparatus and method of improving an insulating film on a semiconductor device. Mitani discloses "A semiconductor device includes a semiconductor substrate, a first

insulating film formed on the semiconductor substrate, and an electrode formed on the first insulating film. The first insulating film contains a halogen element and a combination of silicon and nitrogen or a combination of silicon, oxygen, and nitrogen." See abstract of Mitani.

Mitani fails to disclose a nitrogen atom concentration of more than $1 \times 10^{20} \text{ cm}^{-3}$. The Examiner acknowledges this failure of Mitani at paragraph 4 of the Office Action. Mitani additionally fails to disclose the flat band voltage being stable even if fluorine injection occurs, as is set forth in instantly amended independent claim 2. Mitani additionally fails to disclose the prevention of deterioration of transconductance, as is set forth in new claim 24.

Wristers pertains to silicon oxynitride gate dielectrics. The Examiner turns to Wristers at column 8, lines 2-6, which states, "It is postulated that the concentration of nitrogen atoms at the upper surface of an oxynitride gate dielectric must be at least $1.0 \times 10^{20} \text{ atoms/cm}^3$ in order to prevent boron atoms in the polysilicon gate electrode from penetrating into the gate dielectric."

However, neither Mitani nor Wristers discloses or suggests the interaction of the greater than $1 \times 10^{20} \text{ cm}^{-3}$ nitrogen atom concentration and the fluorine such that the flat band voltage is stable even if fluorine injection occurs, as is set forth in

instantly amended claim 2. See FIG. 2 and page 13 of the specification.

Further, neither Mitani nor Wristers describes the interaction of nitrogen and fluorine to reduce the deterioration of transconductance, as is set forth in new claim 24. See FIG. 7 and page 14 of the specification.

As a result, the combination of Mitani and Wristers would fail to motivate a person having ordinary skill in the art to produce a claimed embodiment of the present invention. Additionally, although the Examiner turns to Gardner for teachings pertaining to a nitrided gate insulator, these teachings fail to address the failures of Mitani and Wristers pertaining to the flat band voltage and the transconductance. Therefore, a *prima facie* case of obviousness has not been made over Mitani and Wristers or Mitani, Wristers and Gardner. Further, even if it assumed *arguendo* that the prior art could be combined to produce a *prima facie* obviousness, this *prima facie* obviousness is rebutted by the unexpected results for the flat band voltage and transconductance set forth in Figures 2 and 7 of the application.

Accordingly, these rejections are overcome and withdrawal thereof are indicated.

Information Disclosure Statement

Applicants thank the Examiner for considering the Information Disclosure Statement filed February 3, 2000 and March 3, 2000 and for making the initialed PTO-1449 forms of record in the application in the Office Action mailed March 28, 2001.

Conclusion

Entry of the above amendments is earnestly solicited. An early and favorable first action on the merits is earnestly solicited.


Attached hereto is a marked-up version of the changes made to the application by this Amendment.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Robert E. Goozner, Ph.D. (Reg. 42,593) at the telephone number of the undersigned below.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

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Attachments

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims:

The claims have been amended as follows:

2. (Three Times Amended) An insulated gate transistor having a gate electrode on a substrate with a gate insulator interposed therebetween, wherein the gate insulator including silicon and oxygen contains both nitrogen atoms and fluorine atoms, and wherein nitrogen atom concentration of the gate insulator is more than $1 \times 10^{20} \text{ cm}^{-3}$, and flat band voltage is stable even if fluorine injection occurs.

Claim 24 has been added.